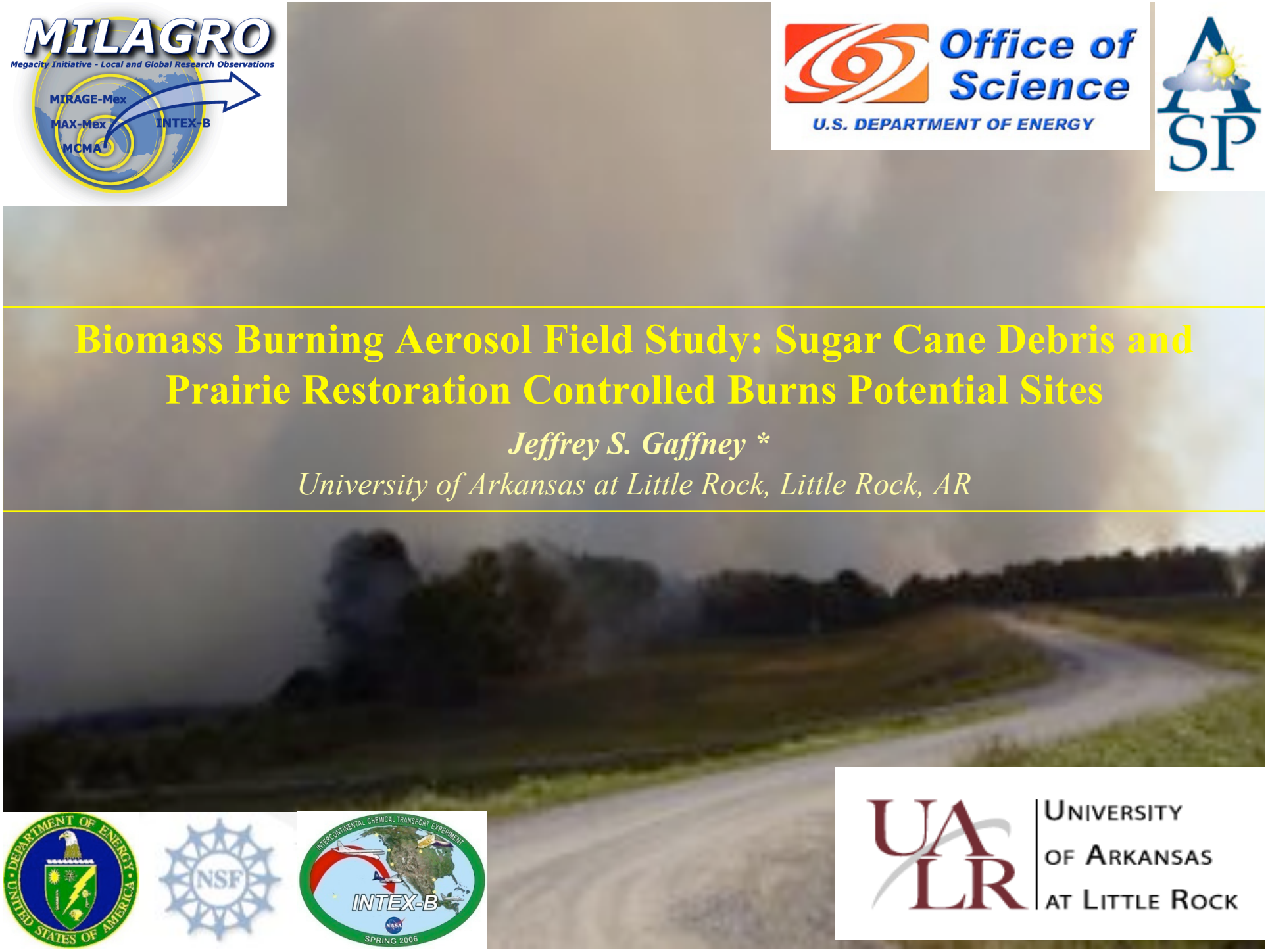

Biomass Burning Aerosol Field Study: Sugar Cane Debris and Prairie Restoration Controlled Burns Potential Sites

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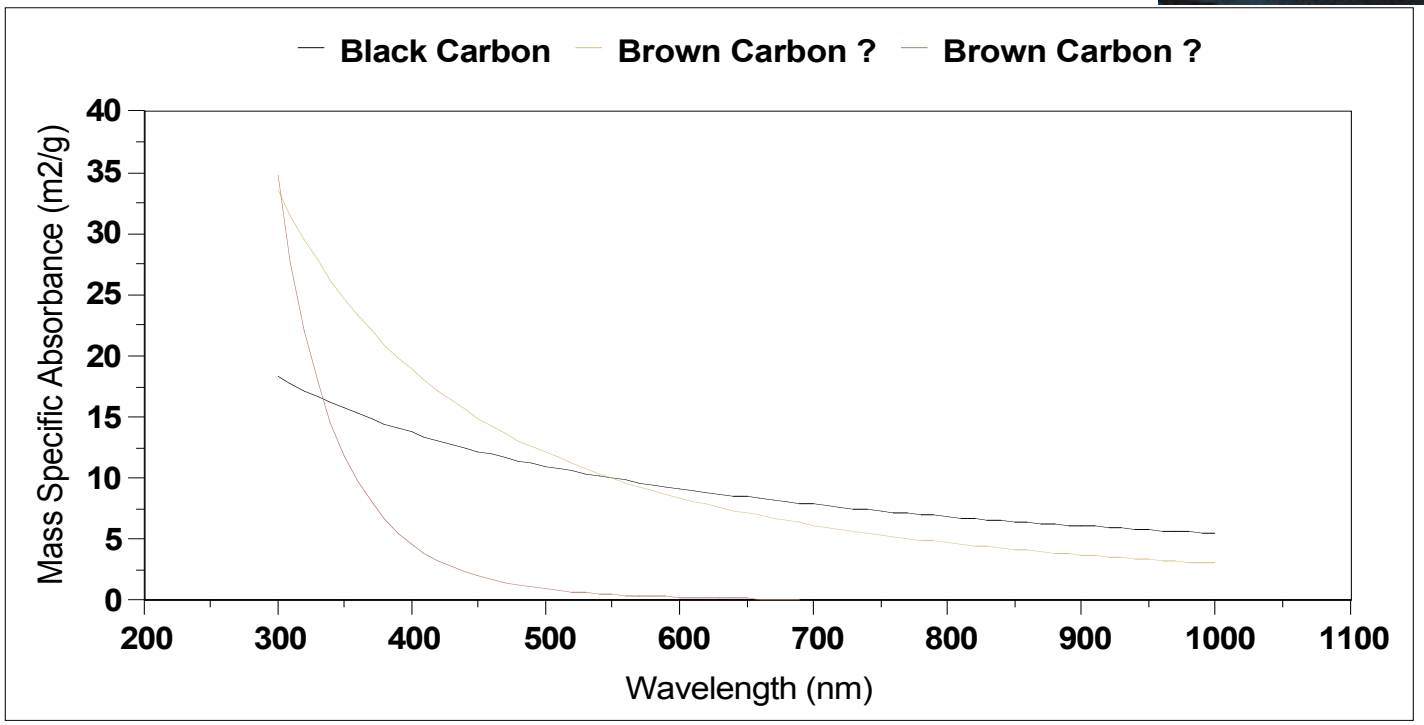
CLIMATE ISSUES:Light Absorbing Aerosol Species

Black Carbon (soot) – combustion sources, not water soluble, refractory
Broadband absorption - UV-Near IR;
λ^{-1} dependence

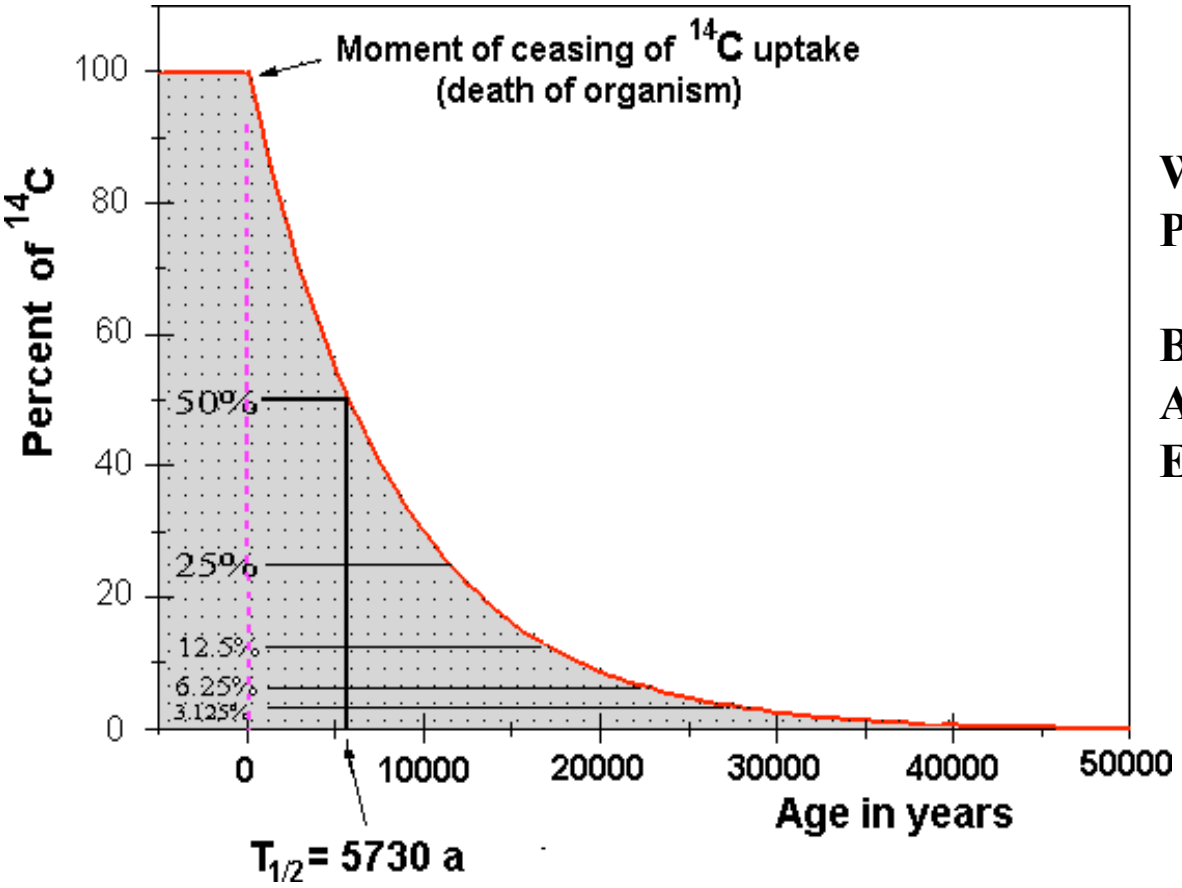
Brown Carbon – water soluble (WSOC)
Broadband absorption - UV-Near IR;
$\lambda^{-\alpha}$ dependence; α = 2-6



BIOMASS BURNING IN VALLEY OF MEXICO – GRASS FIRES

Image courtesy of Telma Castro, UNAM

^{14}C --- Useful Tracer for Biomass vs. Fossil Organic Sources



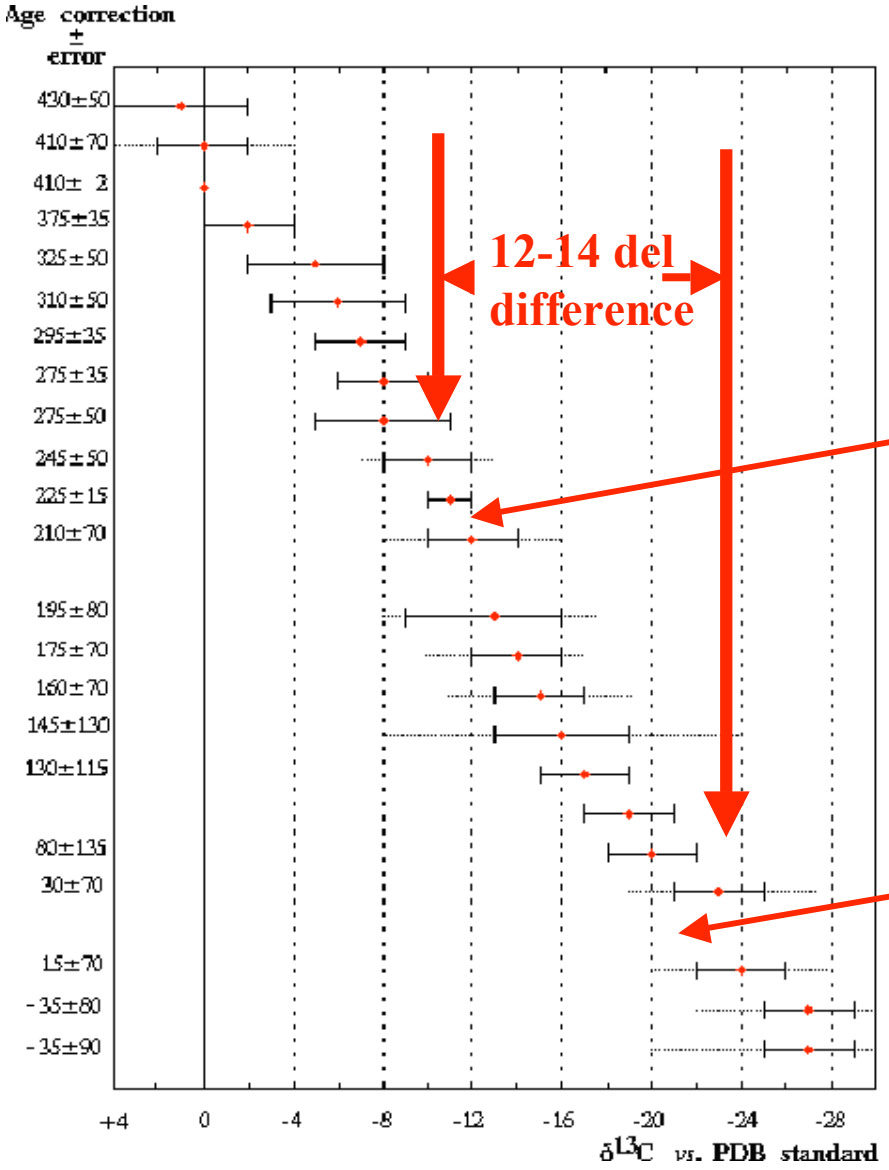
Willard F. Libby - Nobel Prize for 14C dating

Besides Dating in Archeology – Has Uses in Environmental Science!

Biomass is labeled --- Fossil Fuel is 0 (millions of years old)

Amount of C-14 allows Recent vs Fossil Carbon to be Evaluated

Carbon-13 Also USEFUL for SOURCE DETERMINATIONS!



Marine HCO_3^-, CO_3
Saline lacustrine CO_3
PDB $\delta^{13}C$ standard
Bone apatite (C-4 diet)
Soil CO_3 (speleothems, nodules)
Freshwater shells
Bone collagen (C-4)
Atmospheric CO_2
Terrestrial snail shells
C-4 plants (maize, sorghum etc.)
ANU sucrose (^{14}C standard)
Bone apatite (C-3 diet)
freshwater marine plants
Grasses arid zone, sedges, papyrus
Straws, flax
Organic marine organisms
Submerged freshwater plants
Succulents (cactus, pineapple)
Oxalic acid (^{14}C standard)
Bone collagen, wood (C-3 diet)
C-3 plants (wheat, oats, rice, etc.)
graphite, coal
Wood, charcoal
Tree leaves, straw
Peats, humus

C-4

SUGAR CANE

CORN

C-3

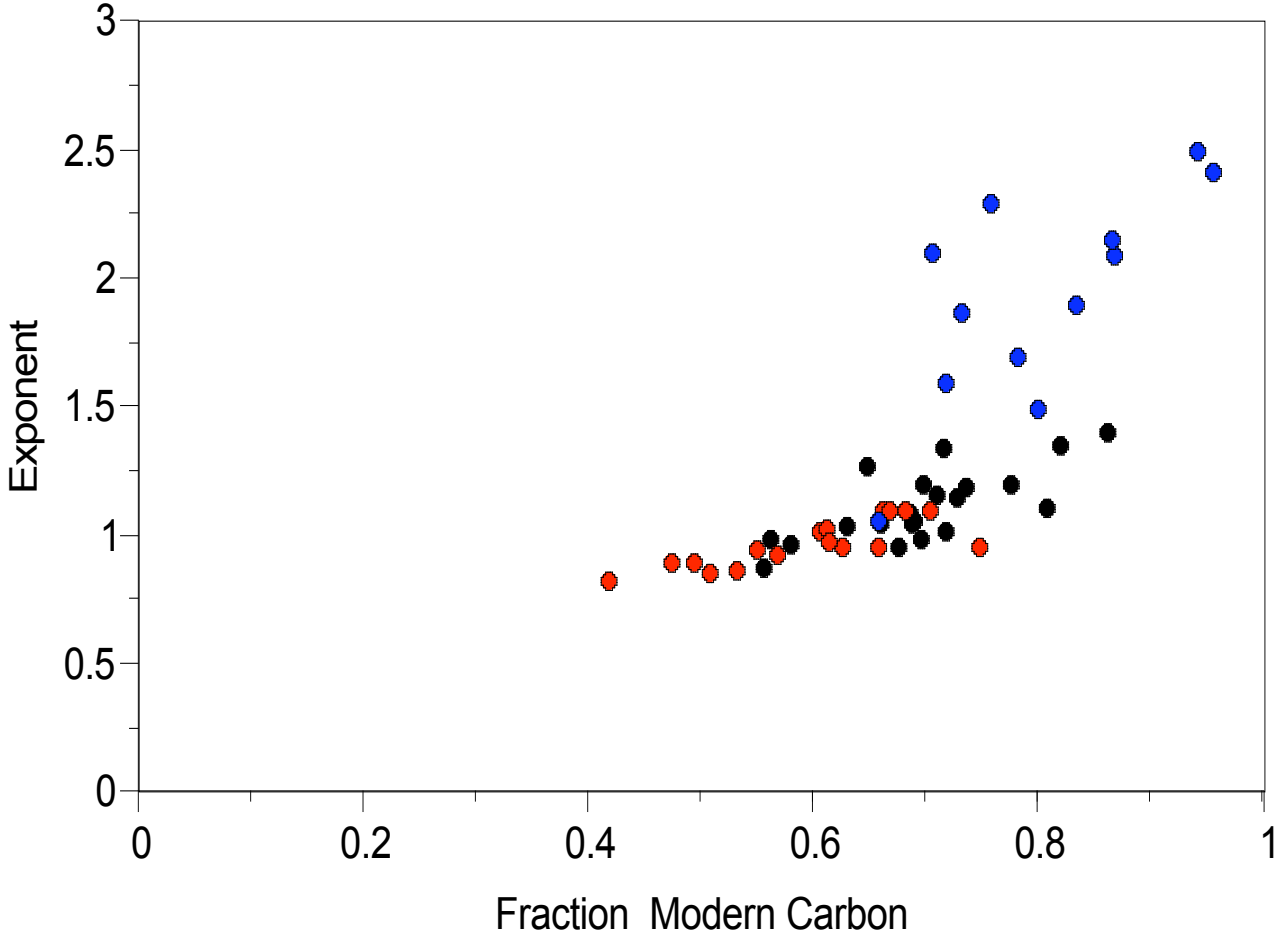
FOSSIL fuels

TREES

RICE

Examples of stable carbon isotopic variation in different sources and ^{14}C correction values. (From M. Stuiver and H.A. Polach, Radiocarbon, 19, 355-363, (1977))

BIOMASS BURNING SAMPLES HAVE ENHANCED UV ABSORPTION…
i.e. Higher AAE's (Marley – Gaffney- Pat Arnott and Colleagues, etc.)



Ångstrom absorption exponent as a function of the fraction modern carbon in Mexico City aerosols in April 2003 (black) and March 2006 (red) and 18 miles north of Mexico City in March 2006 (blue).

SIGNIFICANT BIOMASS SIGNATURES in URBAN ENVIRONMENTS.... INCREASING?

Location	Year	Modern C	Reference
Los Angeles	1982	0.3-0.5	Hildemann
Denver	1996-97	0.3-0.4	Klinedinst
Nashville	1999	0.7	Lewis
Houston	2000	0.5	Allen
Tampa	2002	0.8	Lewis & Stiles
Zurich	2002	0.6	Szidat
Launceston	2003-04	0.9	Jordan
Seattle	2004-05	0.6	Bench
Tokyo	2004-05	0.4-0.5	Takahashi
Phoenix	2005-06	0.5-0.6	Bench

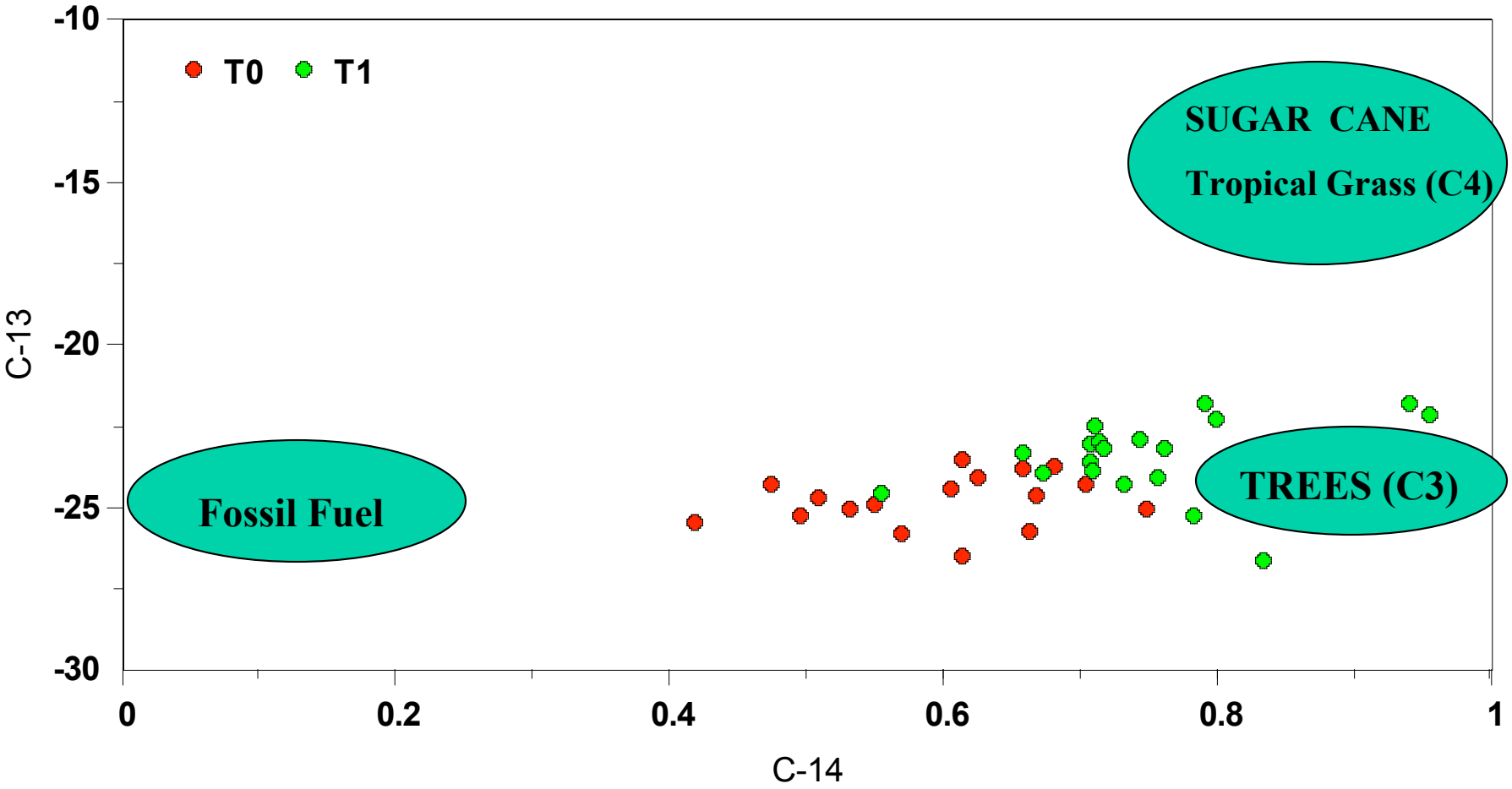
ARCTIC HAZE 1984 0.3-0.4 Gaffney, et al.

INDIA OCEAN….2008 0.6-0.7

Different ORGANIC sources have Different Absorption Properties- CLIMATE IMPLICATIONS!

- ORGANICS are now seen to be more important.. In UV.. Visible, and IR absorption… (HULIS type materials, PAH, etc.)
- Need Aerosol Mass Spec Data along with Aerosol Scattering and Absorption data for these sources..
- OTHER TRACERS.. Levoglucosan, etc. from AMS.. Can also be useful.. And we might find other tracers with new AMS TOF systems.
- HULIS from primary burning vs Secondary Photochemical produced HULIS.. How different in terms of properties and source strengths.. Addresses missing organic sources of aerosols.
- HOW HYGROSCOPIC ARE THEY.. Size, composition and ultimately lifetimes and/or removal-washout rates.

AGRICULTURAL BURNING OF SUGAR CANE DEBRIS… AN OPPORTUNITY…



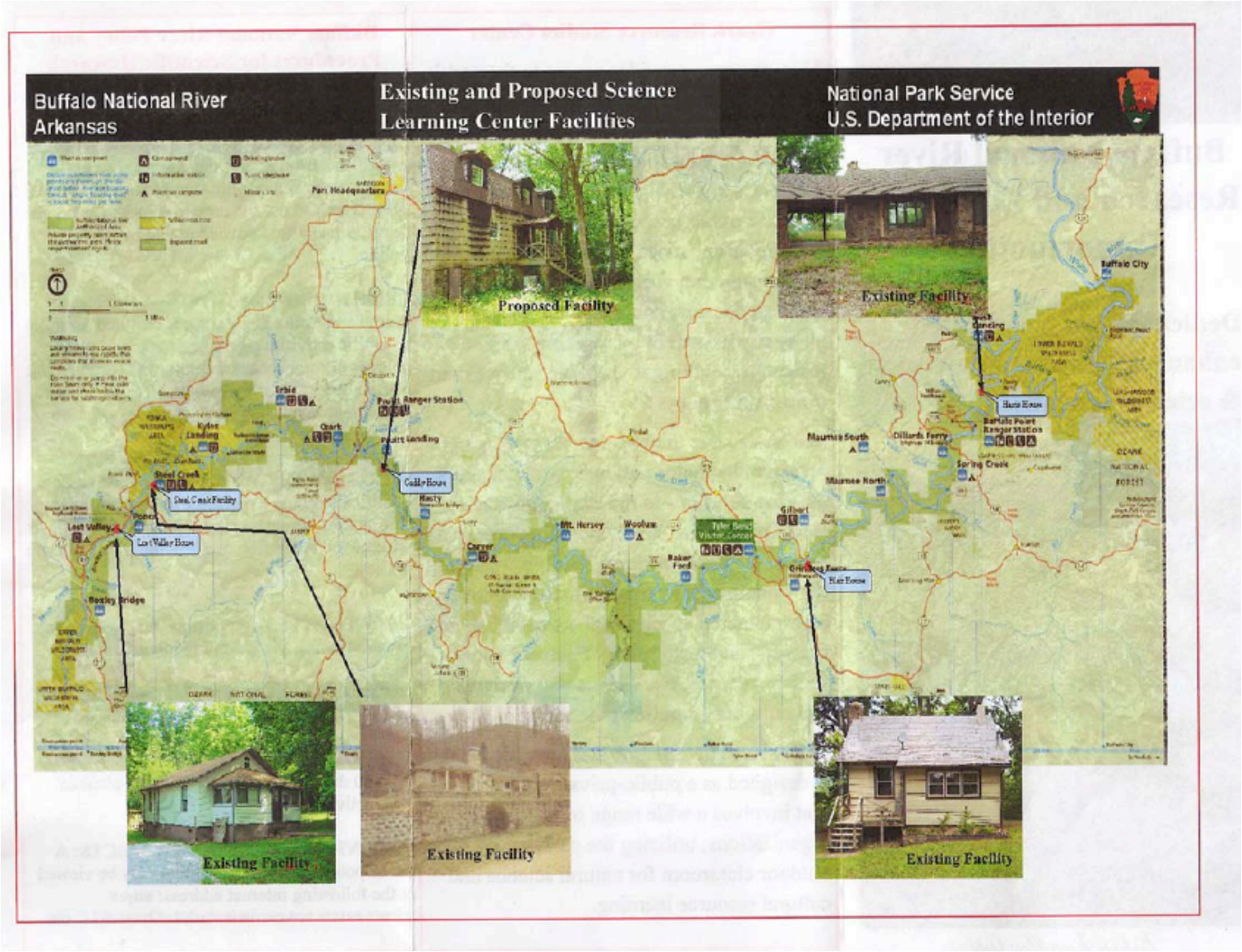
Carbon-13 as a function of carbon-14 content in 12-hour aerosol samples collected at site T0 (red) and T1 (green) during MILAGRO.

POSSIBLE FIELD SITES… LOUSIANA, PUERTO RICO, HAWAII…

Other BIOMASS Burning Issues and Possible Field Studies.

- RICE STRAW Burning – Arkansas is leading producer of rice in U.S. major burning contributor to absorbing aerosols. Other Countries….
- Prairie Burning - Other controlled burning activities would also be a possibility.. To be coordinated with NPS and NFS folks, and NOAA. Yokelson.
- NOTE BIOMASS FIRES ARE LIKELY TO INCREASE IN U.S. and elsewhere with Climate Change.
- Earlier Springs – Longer Growing Seasons – All lead to more BIOFUELS in the Natural Systems..
- Increasing growth period leads to more vegetation.. And drier places that means lots of grass, etc. to burn – California and Georgia/Florida Examples.
- AGRICULTURAL STUDY would be situation where DOE, NSF, USPS, USDA and NOAA to look at how the results might also be related to natural fire sources that are harder to study.. As Agricultural Fires are SET…

Biomass Aerosol Spectra and Sources (BASS) Field Study



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